SELF-TEST

A. Multiple Choice:

1. Which of the following will make a solution basic?

(1) NaCl **(2)** Na_3PO_4 **(3)** NH_3 **(4)** NH_4Cl **(5)** HCN **(6)** KCN

a. (1),(2),(3) **b.** (2),(3),(4) **c.** (2),(3),(6) **d.** (3),(4),(6)

2. When 1×10^{-5} mole of NaOH is added to enough water to make 1.0 L of solution, the resulting solution has a pH of

a. 5 **b.** 6 **c.** 7 **d.** 8 **e.** 9

3. Vinegar generally contains 5% acetic acid. We would expect the pH of vinegar to be approximately

a. 0 **b.** 3 **c.** 7 **d.** 9 **e.** 12

4. Which pair below consists of a Bronsted acid and a Bronsted base?

a. HI, NH_4^+ **b.** SO_3^-, $H_2PO_4^-$ **c.** NH_3, PO_4^{3-} **d.** H_2CO_3, H_3O^+

5. As the hydrogen ion concentration decreases in an aqueous solution

— hydroxide ion concentration increases.
— pH increases.
— the solution becomes less acidic.
— K_w increases.

The number of correct choices is

a. 0 **b.** 1 **c.** 2 **d.** 3 **e.** 4

6. For the acetic acid/acetate ion system, the following ionization constants are defined:

$$HA\ (aq) \rightleftharpoons H^+\ (aq) + A^-\ (aq) \qquad K_a$$

$$A^-\ (aq) + H_2O \rightleftharpoons HA\ (aq) + OH^-\ (aq) \qquad K_b$$

The true expressions are

(1) $K_a + K_b = 1$ **(2)** $K_a \times K_b = K_w$ **(3)** $K_a/K_b = 1$ **(4)** $K_a + K_b = K_w$

a. (1) **b.** (1),(2) **c.** (3),(4) **d.** (2) **e.** none of these

7. The pH of a 0.1 M solution of H_2SO_4 is

a. between 0 and 1 **b.** 1 **c.** between 1 and 2
d. 2 **e.** None of those

8. Consider solutions of the following salts

(1) $CsClO_4$ **(2)** $Cr(NO_3)_3$ **(3)** CH_3NH_2

Listed in order of increasing pH, the correct order is

a. (1),(2),(3) **b.** (2),(1),(3) **c.** (1),(3),(2) **d.** (3),(2),(1)

9. Given the following K_a values

$HC_2H_3O_2$	1.8×10^{-5}	HBrO	5.8×10^{-10}
HCN	5.8×10^{-10}	HF	6.9×10^{-4}
HOCl	2.8×10^{-8}		

Which of the following is the weakest base?

a. $C_2H_3O_2^-$ **b.** BrO^- **c.** CN^- **d.** F^- **e.** OCl^-

10. Sulfurous acid is a diprotic acid. Its ionization occurs in the following steps:

$$H_2SO_3\,(aq) \rightleftharpoons H^+\,(aq) + HSO_3^-\,(aq) \qquad K_{a_1} = 1.3 \times 10^{-2}$$

$$HSO_3^-\,(aq) \rightleftharpoons H^+\,(aq) + SO_3^{2-}\,(aq) \qquad K_{a_2} = 6.3 \times 10^{-8}$$

In a 0.10 M H_2SO_3 solution whose pH has been adjusted to 10, which of the following species would have the highest concentration?

a. SO_3^{2-} **b.** HSO_3^- **c.** H^+ **d.** H_2SO_3 **e.** H_2O

B. Fill in the Blanks

Consider aqueous solutions of the following salts. On the space provided, write **A** if the solution is *acidic* , **B** if the solution is *basic* or **N** if the solution is *neutral.*

_____ 1. $FeCl_3$

_____ 2. NaI and KNO_3

_____ 3. $Mg(OH)_2$ and $CaCO_3$

_____ 4. $CsClO_4$ and KNO_2

_____ 5. NH_4Br and KBr

C. Problems:

Consider two solutions. One solution is 0.1385 M $Ba(OH)_2$. The other is 0.2050 M HBr.

1. Calculate the pH of the HBr solution.

2. Calculate the pH of the $Ba(OH)_2$ solution.

3. If 50.00 mL of the $Ba(OH)_2$ is mixed with 30.00 mL of the HBr solution, what is the pH of the resulting solution?

Consider propionic acid, $HC_3H_5O_2$.

4. Write a balanced equation for the reaction that takes place when it is dissolved in water.

5. Write the K_a expression for this reaction.

6. Calculate K_a for propionic acid if a 500.0-mL solution of propionic acid containing 9.250 g of the acid has a pH of 2.73.

7. A different solution of propionic acid is prepared by dissolving 1.5000 g in enough water to make 2.000 L of solution. Using the K_a calculated in (6), what is the pH of the resulting solution?

8. Is sodium propionate, $NaC_3H_5O_2$ acidic, basic, or neutral? Write an equation to prove your answer.

9. Calculate K_b for $C_3H_5O_2^-$.
10. A 750.0-ml solution contains 20.00 g of $NaC_3H_5O_2$. What is the pH of this solution?

ANSWERS

Exercises:

(E1) 2.5×10^{-7}; slightly acidic **(E2)** 11.899

(E3) 0.017 M **(E4)** 0.65 L

(E5) (1) $HNO_2\ (aq) + H_2O \rightleftharpoons H_3O^+\ (aq) + NO_2^-\ (aq)$

(2) $HNO_2\ (aq) \rightleftharpoons H^+\ (aq) + NO_2^-\ (aq)$

(3) NO_2^- is the conjugate base.

(4) $K_a = \dfrac{[H^+][NO_2^-]}{[HNO_2]}$

(E6) 5.15×10^{-4} **(E7)** 5.83×10^{-5}

(E8) 6.9×10^{-5} M

(E9) $H_2CO_3\ (aq) \rightleftharpoons H^+\ (aq) + HCO_3^-\ (aq)$; $HCO_3^-\ (aq) \rightleftharpoons H^+\ (aq) + CO_3^{2-}\ (aq)$

(E10) $[OH^-] = 6.3 \times 10^{-3}$; pH = 11.80

(E11) acidic, neutral, acidic, basic, basic **(E12)** 8.22

Self-Test

A. Multiple Choice:

1. c	**2.** e	**3.** b	**4.** b	**5.** d
6. d	**7.** a	**8.** b	**9.** d	**10.** a

B. Fill in the blanks

1. A	**2.** N	**3.** B	**4.** B	**5.** A

C. Problems:

1. 0.6882

2. 13.44

3. 12.98

4. $HC_3H_5O_2\,(aq) \rightleftharpoons H^+\,(aq) + C_3H_5O_2^-\,(aq)$

5. $K_a = \dfrac{[H^+][C_3H_5O_2^-]}{[HC_3H_5O_2]}$

6. 1.4×10^{-5}

7. 3.42

8. basic; $C_3H_5O_2^-\,(aq) + H_2O \rightleftharpoons HC_3H_5O_2\,(aq) + OH^-\,(aq)$

9. 7.1×10^{-10}

10. 9.15